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ARROW → Fast, Accurate and Sparse Automatic Facade Reconstruction from Unstructured Ground Laser-Scans

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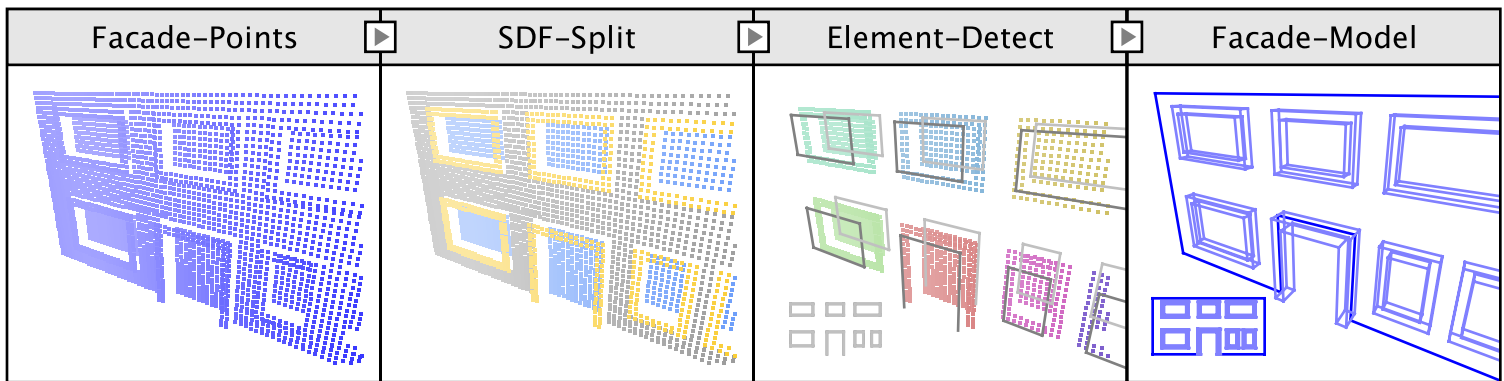
1 → Introduction

What → an efficient data-driven approach to reconstructing 3D architectural facade models from unstructured LiDAR point-clouds.

Why → Surface-reconstruction yields dense mesh [3], which are often too heavy for real-time simulation. Template-driven methods (that exploit facade split-grammars [1]) have low accuracy on irregular facades. Data-driven sparse methods lack semantic structure [2].

Advantages, Applications & Benefits → clean, semantically-rich models without RGB data.

2 → Approach



Accurate
Railed
Reconstruction of
Openings and
Walls

points
↓ in ↓
ARROW
↓ out ↓
mesh

a new algorithm based on quad dominant wall meshing and railed 3D sweeps.

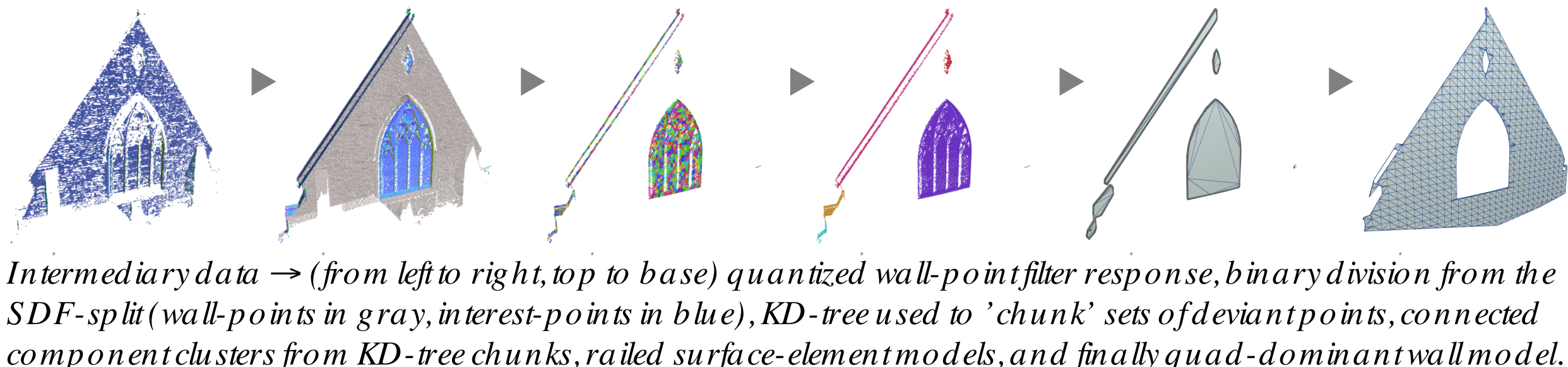
- Step 1:** filter points based on verticality.
- Step 2:** localise on wall using filtered points.
- Step 3:** binary split: wall vs interest points.
- Step 4:** extract connected-components from interest-points using KD-tree.
- Step 5:** rail segmented surface-elements.
- Step 6:** quad dominant cut-out wall mesh.
- Step 7:** return facade → { wall, elements }.

3 → The ARROW Algorithm Illustrated

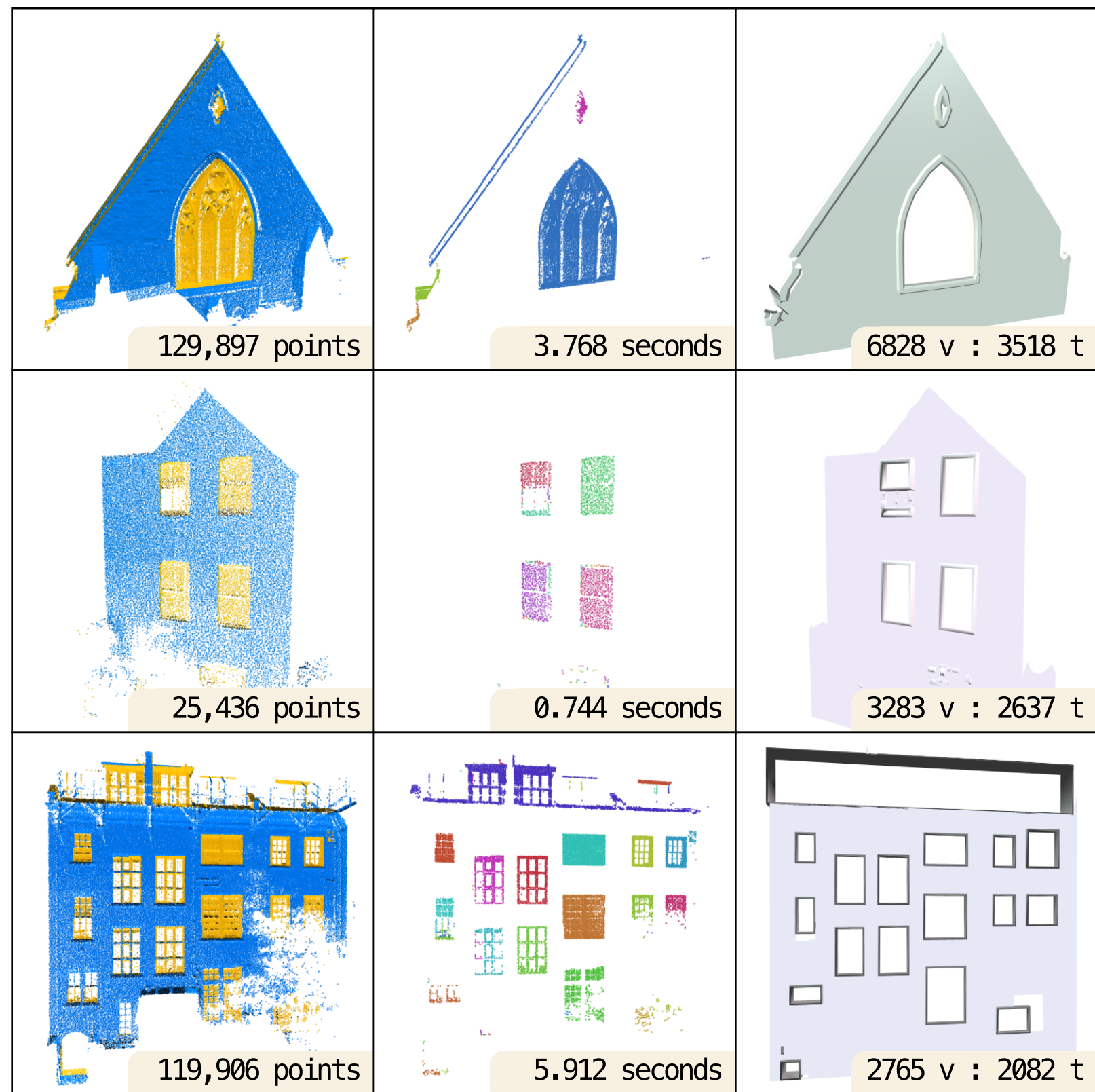


The Key Idea

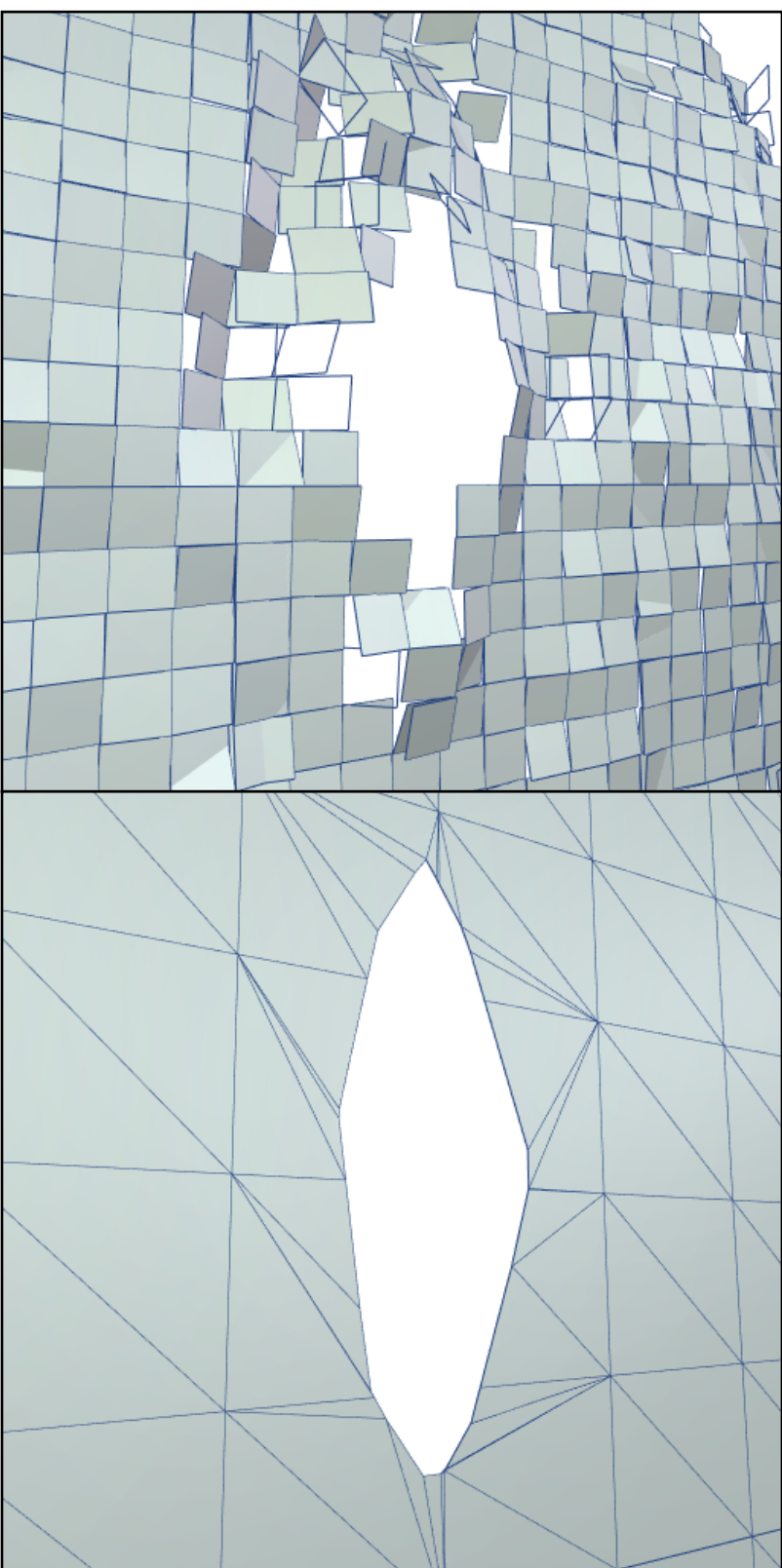
polygon-clipping and 3D-sweeps.



4 → Experimental Results



(left to right) input-points treated with SDF split, connected-components segmented using KD-tree, and finally the output railed facade model.



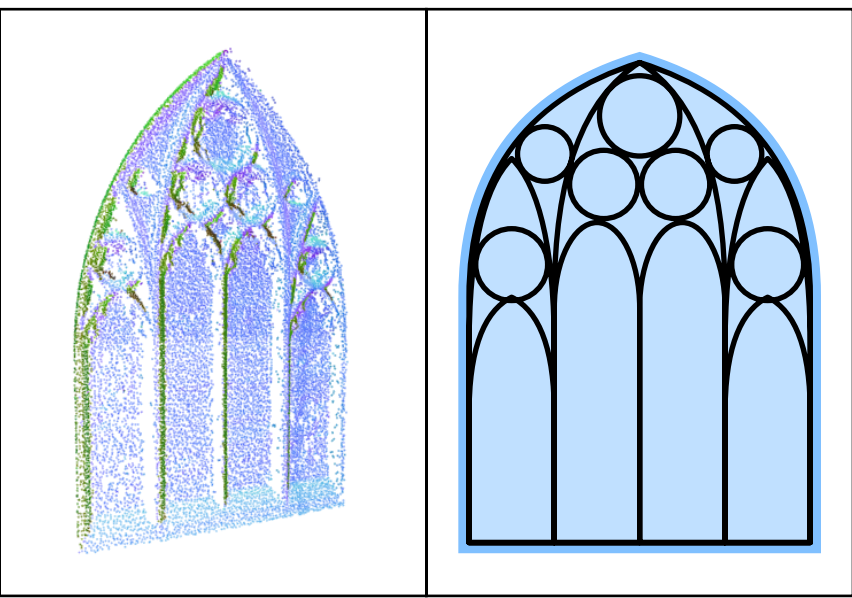
the regular assortment of planes ↑, versus the ARROW algorithm ↓.

The initial results are promising in terms of speed, brevity and geometric accuracy. The next stage is to quantify the accuracy relative to human CAD technicians by considering the precision and recall of the window detection.

5 → Further Research

Frame	Sashes	Sills	Surface-Element
Shape a 2D planar polygon	Panes a procedural 2D split-logic	Shapes a set of open 2D poly-lines	
Profile a 2D planar polygon	Profiles a set of planar 2D polygons	Profiles a set of planar 2D polygons	

Data-Driven modelling of segmented window and door point clusters: (top) the abstract representation of a surface-element, and (right) the key task – 2D split-logic resolution.



6 → References

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